# Relating Bat and Insect Communities in the Context of **White-nose Syndrome and Prescribed Fire**

Shelby Fulton and Luke Dodd, Eastern Kentucky University

## Introduction

- Spatial and temporal partitioning occurs naturally among insectivorous bats
- White-nose Syndrome (WNS) has been associated with relaxed partitioning[1]
- Bat habitat use is largely determined by forest structure[2,3]
- Prescribed fire influences both forest structure and prey availability
- Lepidoptera are of interest due to dietary ubiquity

## Methods

- Mammoth Cave National Park, paired burned and unburned sites
- Burned sites classified as recent or historically burned
- 2010 – 2012 (pre-WNS), 2015 – 2016 (post-WNS)
- Anabat II detectors deployed concurrently with insect black light traps
- Phonic group identifications assigned using BCID Eastern USA v.2.7c
- Lepidoptera clustered into six size classes based on wingspan[4]

## Model Selection

Table 1. Summary of support for the two most parsimonious models for diversity of bat phonic groups detected, calculated as the reciprocal of Simpson's Diversity (1/*D*). Models were constructed as linear mixed models including site as a random effect. Fixed effects in other candidate models included WNS, burn history, and the relative abundances of Lepidoptera, Coleoptera, and Diptera.

| Model | K | AICc | Δ AICc | $W_i$ |
|---|---|---|---|---|
| Null | 3 | 158.5 | 10.4 | 0.00 |
| WNS | 4 | 149.3 | 1.22 | 0.29 |
| Lepidoptera + Coleoptera + Diptera + WNS | 7 | 148.1 | 0.00 | 0.53 |

Table 2. Summary of support for the most parsimonious model for diversity of Lepidoptera size classes, calculated as the reciprocal of Simpson's Diversity (1/*D*). Models were constructed as linear mixed models including month and site as random effects. Fixed effects in other candidate models included WNS, burn history, and the relative abundances of low, mid, and *Myotis* phonic groups.

| Model | K | AICc | Δ AICc | $W_i$ |
|---|---|---|---|---|
| Null | 4 | 258.6 | 13.1 | 0.00 |
| WNS | 5 | 245.6 | 0.00 | 0.83 |

## Ordination

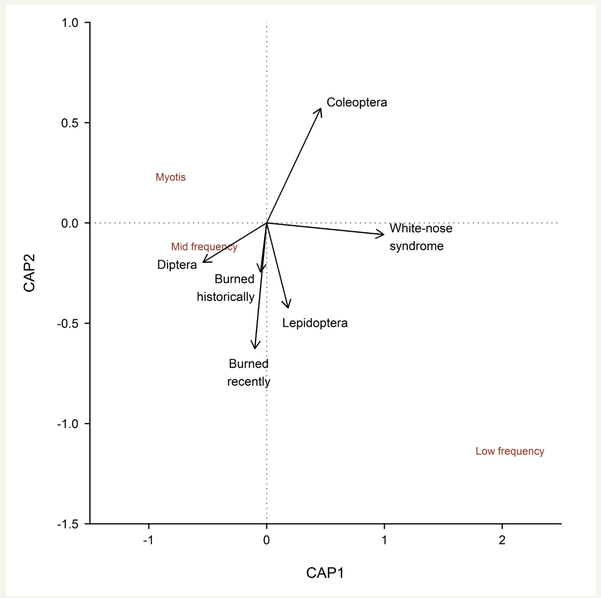


Figure 1. Biplot visualizing the results of distance-based redundancy analysis. Red text represents the numerical abundances of bat phonic groups as estimated by acoustic detection. Arrows represent the constraining variables; all insect variables refer to relative abundance. Ordination was significant ($P < 0.05$). Cumulatively, CAP1 and CAP2 account for 87.2% of the explainable inertia in bat assemblage composition.

## Discussion

- WNS drives bat assemblage diversity and composition
- Burn history is a poor predictor of phonic diversity, but relates to bat assemblage composition
- Recent application of fire has a stronger relationship to assemblage composition than historical burning
- Model selection indicates greater evenness in the post-WNS distribution of Lepidoptera size classes
- dbRDA demonstrates the significant influence of insect prey, burn history, and WNS on bat assemblage composition

### Literature Cited

[1]Jachowski et al. 2014. Disease and community structure: WNS alters spatial and temporal niche partitioning in sympatric bat species. Divers. Distributions 20:1002–1015.

[2]Ford et al. 2005. Relating bat species presence to simple habitat measures in a central Appalachian forest. Biol. Cons. 126:528–539.

[3]Loeb and O'Keefe. 2006. Habitat use by forest bats in South Carolina in relation to local, stand, and landscape characteristics. J. Wildl. Manag. 70:1210–1218.

[4]Fulton. 2017. Local impacts of WNS on the foraging ecology of insectivorous bats. Eastern Kentucky University. 67 pp.

### Acknowledgements

Funding was provided by the Joint Fire Sciences Program (grants #14-1-05-22 and #10-1-06-1), the College of Agriculture, Food, and the Environment at the University of Kentucky, as well as the Department of Biological Sciences and the Graduate School at Eastern Kentucky University. We thank R. Griffitts, J. Deidesheimer, T. Culbertson, J. Winters, J. Johnson, K. Rose, K. Rump, and K. Fletcher for field assistance, as well as R. Toomey, S. Thomas, and S. Trimboli for facilitating our work at Mammoth Cave National Park.